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ABSTRACT

This paper describes the purposes and procedures of a longitudinal study designed to: (1) relate mother-infant interaction patterns to infant age, sex, and social class; (2) relate mother-infant interaction patterns to infant sensory-motor development; and (3) to examine the relationship between infant sensory-motor development and infant sex and social class. Subjects are infants from 5 weeks to 42 weeks of age, from middle and lower class families. Data were collected by mother-infant observation and developmental testing of cognitive and perceptual-motor development. The specific rationale for the study and proposed approaches for analysis of the data are discussed. (Author/BRT)

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A PROGRESS REPORT: THE RELATIONSHIP BETWEEN MOTHER-INFANT INTERACTION AND SENSORY-MOTOR DEVELOPMENT ACCORDING TO AGE, SEX AND SOCIAL CLASS BACKGROUND[1]

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This paper reports the progress of a research project dealing with infants between one and ten months of age. This project was started in the spring of 1969 and is now nearing completion. There were three purposes of the project. Using an observational scale designed for recording mother-infant interaction patterns, the first purpose was to relate these interaction patterns to three demographic variables: the age, sex and social class background of an infant. A second purpose was to relate these mother-infant interaction patterns to early forms of cognitive functioning in infancy, namely, sensory-motor development. A third purpose of the project was to examine the relation between sensory-motor development and the sex and social class background of an infant.

Within this paper, the specific rationale behind each of these three purposes and the procedures employed for implementing them are outlined. Several approaches are proposed for analysis of the data.

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In the literature dealing with human infants, strong evidence continues to accumulate which shows that environmental factors are related to relatively enduring, stable response patterns. From this evidence, a number of studies carried out reflect a general recognition that certain aspects of the social human environment are at least as important as the physical environment in influencing such behaviors as stranger anxiety (Robson, Pederson, & Moss, 1969) and exploration (Rubenstein, 1968).

However, the valid reliable assessment of a dynamic social human environment is usually fraught with more difficulties than the assessment of a relatively static, non-social physical environment. A perusal of caretaker-infant interaction studies reveals the large number of discrete behavioral combinations and levels of behavioral abstraction that an investigator can find in these dyadic relationships. As a result, it is hardly surprising that the descriptive categories of these studies have differed widely in their level of specificity. Some have employed broad descriptive categories extending over many months of life (e.g., Sauder, 1969) while others have used highly discrete response units which may change second by second (Gewirtz & Gewirtz, 1965; 1967). Between these two extremes a rather reliable and objective technique for describing mother-infant interaction up to three months of age has recently been reported by Moss (1967) and was modified for use in the present study.

The Role of Age, Sex and Social Class in Mother-Infant Interaction

As a first step towards establishing a relationship between an infant's human environment and an infant's behaviors, most studies of mother-infant interaction patterns have initially sought only to describe these patterns. Using the modified technique originally developed by Moss (1967) and extending the age of the infants studied up to ten months, one of the primary purposes of the present study was to describe patterns of mother-infant interaction according to three demographic variables. These were: the age of an infant, the sex of an infant and the social class background of an infant.

It is reasonable to suspect that each of these variables may directly

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affect the frequency of certain discretely or conjunctively occurring response clusters which are involved in mother-infant interaction. Certainly, the most likely variable to affect this interaction is an infant's age. In this regard, several have speculated and some have provided evidence that mother-infant interaction is a series of constantly shifting mutual adaptations which change with an infant's age (e.g., Appell & David, 1965; Moss, 1967; Sander, 1969). Additional evidence suggests that mother-infant interaction is affected by an infant's sex although practically no data from this period of life has been gathered past three months of age (Moss, 1967).

Finally, with regard to the social class variable, some investigators (e.g., Bernstein, 1961; Hess & Shipman, 1965) have distinguished class differences in linguistic patterns of interaction between a mother and her preschool child although no study, outside of clinically oriented descriptions, has extended these observations to patterns of mother-infant interaction. On the basis of these observations in preschool children, it may be speculated that minimal class differences exist early in an infant's life when caretaking is centered around more perfunctory activities such as diapering, feeding, etc.; however, as social linguistic forms of communication become increasingly important later in the first year of life, early forerunners of maternal communication styles observed by other researchers in the preschool period may be detected in infancy.

The Relationship Between Mother-Infant Interaction and Sensory-Motor Development

An additional purpose of the present study was to relate these patterns of mother-infant interaction to some indices of cognitive functioning in infancy. For this purpose, three scales of sensory-motor development, schema development, vocal imitation and gestural imitation, were adopted from Uzgiris and Hunt's (1966) instrument for assessing infants' psychological development.

In these scales items are achieved in an invariant sequence so that to achieve higher, more advanced stages it is necessary to first pass through lower, less advanced items in a scale. The scale of schema development consists of a series of progressively more advanced sensory-motor actions (e.g., mouthing, grasping, striking, dropping) which an infant can utilize in interacting with objects. The vocal imitation scale contains items such as reciprocal smiling and cooing, and imitation of familiar and unfamiliar words. The gestural imitation scale contains items which represent increasingly difficult gestures such as familiar gestures (waving "bye-bye"), unfamiliar gestures (clapping blocks together) and invisible gestures (eye-blinking).

As suggested above, two general classes of environmental influences which can affect early forms of cognitive functioning in infants are the human social environment and the non-human, physical environment. A plausible hypothesis which derives from this distinction is that mother-infant interaction will be related to vocal and gestural imitation though not necessarily to schema development. It may be argued that the

development of imitative processes especially requires contingent, reciprocal forms of social interaction and reinforcement similar to those found in mother-infant interaction. On the other hand, schema development, which focuses on interaction with objects in the environment represents a series of behaviors which, given certain minimal stimulus prerequisites in the physical environment, will develop in almost endogenous fashion.

The Role of Sex and Social Class in Sensory-Motor Development

Given the design of the first two parts of the investigation, it was also possible to examine the relationship between the variables of age, sex and social class, and the three scales of sensory-motor development already outlined above. Since age has been previously related to performance on these scales (Uzgiris & Hunt, 1966), its importance will derive only from its possible interaction with the sex or social class background of an infant.

Some research suggests that female infants are ahead of male infants on certain aspects of sensory-motor development (Uzgiris, personal communication) although the findings are still inconclusive. Concerning social class differences in sensory-motor development and other developmental quotients, the evidence has been mixed. For instance, on one side, Wachs, Uzgiris and Hunt (1967) using some sensory-motor scales and other cognitive tasks found infants from middle class backgrounds to be advanced over those from lower class backgrounds at various points throughout an age span of seven to twenty-two months. On the other side, Golden and Birns (1968; 1969) using a test of object permanence and the Cattell Infant Intelligence Scale, found no differences between infants of lower and middle class backgrounds.

In part, the different ages, definitions of social class, testing procedures and types of test items used by the two sets of studies may account for their different findings. However, in the present study a specific expectation congruent with an hypothesis outlined above was held; namely, that differences favoring infants from middle class backgrounds would be observed in vocal and gestural imitation though not necessarily in schema development. Similar to the reasoning outlined above, it is argued that language behaviors which become so important in the preschool years and imitative behaviors which predominate in infancy both may be influenced by a common denominator; that is, contingently reinforced forms of social interchange. It is this common denominator which may be primarily missing in lower class environments and is reflected during the preschool years in language development. If this is true, then differences between infants from lower and middle class backgrounds should occur in the development of imitative behaviors.

To summarize the purposes of the present investigation, the first was to relate patterns of mother-infant interaction to three demographic variables of age, sex and social class. A second purpose of this study was to relate these patterns of mother-infant interaction to sensory-motor

development. The expectation was that the human environment provided by the mother would be more closely related to verbal and gestural imitation than to schema development. A final purpose of the study was to relate the sex and social class background of an infant to its sensory-motor development. While sex differences are inconclusive and therefore no prediction could be made, it was hypothesized on the basis of limited evidence that middle class infants would be more advanced on imitative behaviors but not necessarily on schema development.

Method

Subjects

The sample, at this point in the data collection, consists of 30 infants from a middle class background and 20 infants from a lower class background. Twenty out of 30 infants in the middle class and 10 out of 20 infants in the lower class were only children. The remaining had only one older sibling.

The projected sample will contain three age groups of 20 infants each; a youngest group ranging in age from 5 to 7 weeks, a middle group ranging in age from 18 to 22 weeks and an oldest group ranging in age from 38 to 42 weeks. The primary criteria for distinguishing middle from lower class groups was educational level. In the middle class group at least one parent had attended college and, in a majority of instances, at least one parent had obtained or was working towards a post-graduate degree. In the lower class sample neither parent had gone further than high school and in many instances did not complete high school. Approximately sixty percent of the lower class sample was receiving some form of welfare because the father was absent. All of the middle class sample were white whereas fifty percent of the obtained lower class sample were white and fifty percent were Negro.

These two demographic variables, along with the variable of sex, will produce a balanced 3x2x2 design containing a total of 60 infants, 20 from each of three age levels, 30 from each social class and 30 of each sex.

Procedure

The procedure can be best described in terms of three separate visits to an infant's home. After having secured agreement to participate in the study, a female interviewer-observer made an initial visit to the home to become acquainted with the mother and infant, the surroundings and the tempo of the environment. This visit also served to make the mother and infant more at ease with a stranger in the home. Besides talking informally with the mother about the infant's habits, abilities and schedules, the observer administered in an informal manner an inventory of home stimulation . . . "designed to sample certain aspects of the quantity and, in some ways, the quality of social, emotional, and cognitive stimulation available to a young child within his home" (Caldwell, Heider, & Kaplan, 1967). The scale has a reported inter-observer agreement of 94.6%.

Also, during this first visit approximately one-half hour of mother-infant interaction was recorded using the observation instrument to be described below. The observation of mother-infant interaction was performed only to acquaint the mother with the procedure. None of the recorded behaviors from this first day were used in the data analyses. The length of the first visit usually varied between one and two hours.

Within a few days after the initial visit the same O made a second visit. At this time, four continuous hours of mother-infant interaction were observed and recorded. It was stressed to the mother during the first visit and at the beginning of the second visit that the mother should proceed normally in her daily activities. Although this obviously was a difficult request for the mother to comply with, it was felt that a high amount of cooperation was obtained. Three aspects of the procedure strengthened this feeling. First, some initial acquaintance had already been made between the mother and O during the first visit. Second, all Os were female, a point which many mothers claimed put them more at ease than if O were male. Finally, O stressed that her primary interest was in the infant, not the mother. Therefore, she did not feel as if she was under investigation. To reinforce this belief, O stayed with and observed the infant, not the mother, when mother and infant were in separate rooms. The mother-infant interaction behaviors gathered during this four hour period were used in the data analyses.

Within one week after the second visit, the senior author made a third and final visit to the infant's home to administer the scales of schema development, vocal and gestural imitation. Because practically none of the items in these scales can be meaningfully administered to infants under five or six weeks of age, no data on sensory-motor development were gathered for the youngest group.

Mother-Infant Interaction Scales

As mentioned in the introduction the scales used for observing and recording mother-infant interaction behaviors were adapted from a technique reported by Moss (1967). A list of the 46 discrete maternal and infant behaviors included in this modified scale is shown in Table 1.

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Insert Table 1 about here
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Modifications in Moss' original scale were made for several reasons. First, changes were made where it was felt that a single behavior in Moss' scale could be more reliably and meaningfully described as two behaviors. For instance, the stimulates/arouses infant category was differentiated so that arouses in the present scale only refers to maternal interaction in the tactual modality whereas arousive interaction in the visual modality is designated as displays object. The scale was also modified to include reciprocal forms of interaction (verbal and gestural). It was felt that these reciprocal forms of interaction could be reliably scored and, further, it became unnecessary to tie up two sequentially occurring, discrete behaviors at a later point in the analysis. Finally, several items were added to the scale which was originally designed for

infants up to three months. These items, such as stand and crawl, were added to include the activities of the older infants included in the present study.

The upper and lower portions of Table 1 indicate infant and maternal behaviors respectively. Most of the 29 discrete infant behaviors can be grouped into larger classes such as position, auditory behaviors, visual behaviors, locomotion behaviors, manipulative and gestural behaviors. Some of the specific discrete behaviors are not fully obvious and deserve more detailed definition. Ventral to ventral indicates a position where the mother holds her infant to her chest. Auditory reciprocates indicates an infant's auditory response to a verbal response of the mother. The various specific behaviors among visual, locomotion and manipulative classes refer to the object of an infant's orientation. Among the mouthing behaviors, schema refers to an infant who mouths non-nutritive objects (excluding fingers and pacifiers) such as rattles, blocks, clothing, etc.

Maternal behaviors have been grouped into four modalities of interaction (plus feeding). These are tactual, visual, verbal and gestural modalities. Among the tactual behaviors, attends refers to such behaviors as adjusting clothing, diapering, powdering and other activities which are brief and perfunctory. Affectionate contact refers to such behaviors as soothing actions, kisses or cuddling infants. Arouses includes maternal behaviors which have an arousing effect on the infant, e.g., tickling, pinching. Included among stresses musculature would be propping an infant up to stand, or having an infant grab the mother's finger and shaking the finger. Among the verbal behaviors a mother may initiate a verbal response through the use of adult or baby talk (such as cooing or simple guttural sounds). Also she may reciprocate to an infant's initiation of verbal interchange. Finally, among gestural behaviors, a mother may display objects to an infant, she may display hands or faces (such as pointing, playing patti-cake or making faces), she may reciprocate gesturally to some gesture performed by an infant or she may smile.

Using a clip-board and stop watch the occurrence of these behaviors was recorded onto check-lists every thirty seconds for four continuous hours. Thus, because there are 480 one-half minutes in four hours, the frequency of any of the behaviors in Table 1 could range from 0 to 480. In his report, Moss (1967) recorded behavior occurrences every minute while in the present study it was felt that more infrequent recording every minute lost too much behavior, especially for older, more active infants.

Training of Os. Prior to any data collection, there was a fairly intensive training procedure for observing, selecting and recording mother-infant behaviors. In this training mother and infant pairs not part of the final sample visited a laboratory where various normal sequences of mother-infant behavior were observed and recorded by Os through a one-way vision mirror and, in some instances, these sequences were videotaped. This permitted playback of mother-infant interaction sequences for extensive discussion and clarification of particular behaviors, redefinition of some behaviors, and, occasionally addition or deletion of behaviors. The final scale adopted is the one given in Table 1.

Interobserver reliabilities. Once the final scale was in final form, interobserver reliabilities were gathered in the laboratory. Ten mothers and their infants ranging in age from two to nine months, who were also not part of the sample under study, carried out various spontaneous interactive sequences for periods of one-half hour. The mothers were informed of the purpose of this aspect of the study and were encouraged to interact normally with their infants. Observation of these sequences by the Os was through the one-way vision mirror mentioned above. Because the tempo of interaction was rapid and fairly intensive during this time (in comparison with normal home situations), the median reliabilities for each behavior are listed in Table 1. For some behaviors the reliabilities are not listed because the behaviors did not occur at all in the laboratory or occurred too infrequently to be meaningful.

An attempt was also made to obtain reliabilities for the sequences of discrete behaviors within half-minutes by marking the occurrence of a behavior with a number. However, with the present use of a check list, recording of sequences was found to be unreliable. Undoubtedly, the success of those who have been able to obtain reliable observations of behavioral sequences can be attributed to their use of verbal codes, not check lists, to record ongoing behavioral sequences (e.g., Bobbitt et al., 1969).

Scales of Sensory-Motor Development

The series of invariant items for the three scales of schema development, vocal and gestural imitation are listed in Table 2. An infant was credited for the highest item attained on each of these scales.

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Insert Table 2 about here
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In the present study no interobserver reliabilities were obtained for the sensory-motor scales although previously reported reliabilities of the items in these scales have all been above .82 with a median reliability of .95 (Uzgiris & Hunt, 1968). True, a possible bias may have existed in the scoring of male vs. female or lower vs. middle class infants, and any results relevant to these variables must be interpreted with some degree of caution. However, in correlating performance on the sensory-motor scales with various patterns of mother-infant interaction, a possible bias effect was absent since the collection of these two sets of data were obtained independently by different experimenters.

Progress of Data Collection, Data Condensation and Data Analyses

At the time of this writing, data collection and data condensation are still underway. Ten infants from lower class backgrounds remain to be seen before the sample size of sixty is complete.

The transferral of the data from the middle class sample onto punch cards is almost complete and analysis on this portion of the sample will begin shortly. Upon completion of the data collection of the lower

class sample, this portion will then be integrated into analyses about to begin on the middle class sample.

It may also be mentioned here that data condensation and transferral of the data onto punch cards requires large numbers of man hours. For every four hours of mother-infant observation and recording, an additional six to seven hours are required before the data appears on punch cards. This should not be surprising when one considers the possibility that any one, and often as many as twelve different, discrete behaviors occur in half-minute periods--and there are 480 half-minute periods in the four hours of data collection for a single mother-infant dyad. To increase efficiency, future research in this area should explore methods whereby data can be collected and easily transformed into "computer readable" material. Several methods have been developed for this purpose although, except for optical scanning data cards which may be adapted for recording mother-infant interaction, the cost of most of these methods is prohibitive (Mostofsky, 1969).

As a "first run" through the data, only descriptive statistics containing means and variances will be obtained. Equipped with some plausible hypotheses from these preliminary statistics, a next step might be analyses of variance of the frequencies of certain discretely occurring behaviors, e.g., reciprocal vocalizing, smiling, etc. using age, sex and social class as independent variables.

Similar analyses of variance may be undertaken not merely on frequencies of single bheaviors but also on the frequency of conjunctively occurring behaviors, i.e., those behaviors which occur together in the same half-minute. This method attempts to measure behavior occurrences which happen simultaneously or in rapid succession. From such a method it is possible to determine if the frequencies of such conjunctively occurring behaviors are related to the age, sex or social class background of an infant. The precise combinations of behaviors to be examined are not entirely clear yet, although several likely combinations will be tried following closer examination of the data.

On another level, cluster or factor analysis of the forty-six behaviors at different ages may permit a more precise elaboration of the shifting, mutual adaptations between mother and infant. The factors to emerge at each age from such an analysis cannot be meaningfully predicted yet.

Quite obviously, the data on mother-infant interaction alone contains an overwhelming number of analyses that can be performed. Therefore, analyses will have to be guided by a mixture of parsimony, theoretical expectations, intuition and previous analyses.

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Table 1

Forty-six behaviors and their median interobserver reliabilities utilized in observation and recording of mother-infant interaction

Infant Behaviors		Median r
State	Active awake	.98
	Passive awake	.75
	Drowsy	---
	Sleep	---
Position	Sitting	.81
	Standing	.95
	Supine	.98
	Crawl	.98
	Prone	.99
	Ventral to ventral	---
Auditory	Initiates	.95
	Reciprocates	.71
	Fuss	.90
	Cry	.92
Visual	Looks at mother	.81
	Looks at object	.92
	Looks at other person	.89
Locomotive	Towards mother	.70
	Towards object	.98
	Towards other person	---
Manipulative	Manipulates mother	.82
	Manipulates object	.98
Gestural	Initiates	.54
	Reciprocates	.47
	Smiles	.93
Mouthing	Schema	.97
	Fingers	---
	Pacifier	---
	Nutritive	---

Table 1 (con'd.)

Maternal Behaviors		Median r
Tactual	Holds close	.53
	Holds distant	.98
	Attends	.77
	Rocks	---
	Affectionate contact	.97
	Arouses	.86
	Stresses musculature	.85
Visual	Looks at infant	.90
Verbal	Adult	.73
	Baby	.86
	Reciprocal	.95
Gestural	Displays object	.89
	Display of hands or face	.55
	Reciprocal	---
	Smiles	.71
Feeding	Nipple	---
	Spoon/cup	---

Table 2

Items contained within sensory-motor scales
of schema development, vocal and gestural imitation
(after Uzgiris and Hunt, 1966; 1968)[2]

Schema Development

1. Mouthing of a toy put in hand
2. Visual inspection (looking at) at toy in hand
3. Up-and-down hitting a toy with hand or up-and-down hitting of toy on a surface
4. Lateral shaking and waving of a toy in hand
5. "Examining" a toy by manipulating while looking at it
6. Tearing, crumpling, stretching, or sliding a toy
7. Dropping or throwing a toy
8. Socially imitated or reinforced activities, e.g., drinking from a cup, wearing beads, etc.

Vocal Imitation

1. Differentiation of cooing from crying
2. Infant responds with mouth movements, a smile, etc. to E vocalizing sounds often made by infant
3. With E vocalizing cooing sounds often made by infant, infant responds with similar cooing vocalizations
4. Infant vocalizes, but not the same sounds, in response to familiar sound patterns, e.g., "ba-ba", "ta-ta"
5. Infant clearly imitates familiar sound patterns
6. Infant vocalizes sounds to unfamiliar ones vocalized by E but not exact imitations of the unfamiliar sounds

Gestural Imitation

1. Some gestural response is made to a familiar gesture of vertical striking
2. Copies a familiar gesture within the infant's repertoire.
3. Partial imitation of horizontal hitting of two blocks together, i.e., hits a block in E's hand or one on some other surface
4. Succeeds in imitating the horizontal hitting of two blocks together by gradual approximations
5. Imitates horizontal hitting of two blocks together immediately and without approximations
6. Imitates at least one visible but unfamiliar gesture

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2. Higher items beyond the capabilities of infants in the present study have been omitted.